6.0 POTENTIAL EFFECTS OF THE PROPOSED ACTION ON DESIGNATED ESSENTIAL FISH HABITAT OF MANAGED SPECIES

6.1 EVALUATION OF SPECIES REQUIRING EFH CONSULTATION

During the development of this EFH assessment, NMFS websites (NMFS 2006a,b,c) were consulted to develop an initial list of candidate fish species that would be considered for EFH consultation. Because Barnegat Bay encompasses four different 10-minute × 10-minute grids for EFH habitats in addition to the Barnegat Bay complex (Table 1), the initial candidate species list includes organisms living in nearshore estuarine and oceanic habitats (Table 2). During the initial review of life history and EFH requirements for each candidate species, some species or life stages were eliminated from further consideration based on salinity or depth requirements, or life history information that suggested that the appearance of some species or life stage is unlikely in Barnegat Bay, Oyster Creek, or Forked River (Table 3). Table 4 gives the final list of species and life stages that were evaluated in this EFH assessment.

Table 1. Essential Fish Habitat Areas Associated with Barnegat Bay

North	East	South	West	Web Address
40° 10.0'N	74° 0.00'W	40° 00.0'N	74° 10.0'W	http://www.nero.noaa.gov/hcd/STATES4/new_jersey/40007400.html
40° 00.0'N	74° 0.00'W	39° 50.0'N	74° 10.0'W	http://www.nero.noaa.gov/hcd/STATES4/new_jersey/39507400.html
39° 50.0'N	74° 10.0'W	39° 40.0'N	74° 20.0'W	http://www.nero.noaa.gov/hcd/STATES4/new_jersey/39407400.html
39° 40.0'N	74° 10.0'W	39° 30.0'N	74° 20.0'W	http://www.nero.noaa.gov/hcd/STATES4/new_jersey/39307410.html
Barnegat Bay, New Jersey				http://www.nero.noaa.gov/hcd/nj1.html

6.2 SPECIES DESCRIPTIONS AND IMPACT DETERMINATION

EFH requirements for the relevant species and life stages presented in Table 4 are discussed in this section. Species descriptions include, if available, information on fish abundance patterns in Barnegat Bay, common depth distributions, migratory and spawning habits, tolerance and preference ranges for temperature and salinity, habitat needs, and information on food preferences. For each species and life stage, OCNGS operations were evaluated to determine whether they resulted in (1) no adverse impact, (2) minimal adverse impact, or (3) substantial adverse impact on EFH. These impact categories follow the standard used by

Table 2. Initial List of Candidate Species and Life Stages Considered for Inclusion in EFH Assessment

		Life Stage				
Scientific Name	**Common Name**	**Egg**	**Larvae**	**Juvenile**	**Adult**	**Spawning Adult**
Carcharhinus obscurus	dusky shark		◆[a]			
Carcharhinus plumbeus	sandbar shark		◆[a]	◆	◆	
Centropristis striata	black sea bass			◆	◆	
Clupea harengus harengus	Atlantic sea herring			◆	◆	
Gadus morhua	Atlantic cod				◆	
Galeocerdo cuvier	tiger shark		◆[a]	◆		
Glyptocephalus cynoglossus	witch flounder	◆				
Hippoglossoides platessoides	American plaice			◆	◆	
Leocoraja erinacea	little skate			◆	◆	
Leucoraja ocellata	winter skate			◆	◆	
Limanda ferruginea	yellowtail flounder	◆	◆			
Lophius americanus	monkfish	◆	◆			
Merluccius bilinearis	whiting	◆	◆	◆	◆	
Paralichthys dentatus	summer flounder		◆	◆	◆	
Peprilus triacanthus	Atlantic butterfish			◆		
Pomatomus saltatrix	bluefish			◆	◆	
Pseudopleuronectes americanus	winter flounder	◆	◆	◆	◆	◆
Rachycentron canadum	cobia	◆	◆	◆	◆	
Raja eglanteria	clearnose skate			◆	◆	
Scomberomorus cavalla	king mackerel	◆	◆	◆	◆	
Scomberomorus maculatus	Spanish mackerel	◆	◆	◆	◆	
Scophthalmus aquosus	windowpane flounder	◆	◆	◆	◆	◆
Spisula solidissima	surf clam			◆	◆	
Stenotomus chrysops	scup			◆	◆	
Urophycis chuss	red hake	◆	◆	◆		
Zoarces americanus	ocean pout	◆		◆	◆	

(a) Neonates and/or early-stage juveniles.

Table 3. Species and Life Stages Eliminated from Consideration in EFH Assessment and Rationale for Elimination

Common Name	Life Stages Eliminated from EFH Assessment	Rationale for Elimination
American plaice	All life stages	Salinity and depth requirements not present in Barnegat Bay
Atlantic butterfish	All life stages	Depth requirements not present in Barnegat Bay
Atlantic cod	All life stages	Salinity and depth requirements not present in Barnegat Bay
Atlantic sea herring	All life stages	Salinity and depth requirements not present in Barnegat Bay
Black sea bass	Adults (juveniles retained)	Depth requirements not present in Barnegat Bay
Bluefish	Adults (juveniles retained)	Salinity requirements not present in Barnegat Bay
Cobia	All life stages	Salinity requirements not present in Barnegat Bay
King mackerel	All life stages	Salinity requirements not present in Barnegat Bay
Monkfish	All life stages	Depth requirements not present in Barnegat Bay
Ocean pout	All life stages	Salinity requirements not present in Barnegat Bay
Red hake	Juveniles (eggs and larvae retained)	Salinity requirements not present in Barnegat Bay
Spanish mackerel	All life stages	Salinity requirements not present in Barnegat Bay
Summer flounder	Larvae (juveniles and adults retained)	Depth requirements not present in Barnegat Bay
Whiting	All life stages	Depth requirements not present in Barnegat Bay
Witch flounder	All life stages	Salinity and depth requirements not present in Barnegat Bay
Yellowtail flounder	All life stages	Salinity and depth requirements not present in Barnegat Bay

Table 4. Species and Life Stages Included in EFH Consultation

Common Name	Egg	Larvae	Juvenile	Adult	Spawning Adult
	Life Stage				
Black sea bass			◆		
Bluefish			◆		
Clearnose skate			◆	◆	
Dusky shark		◆[(a)]			
Little skate			◆	◆	
Red hake	◆	◆			
Sandbar shark		◆[(a)]	◆	◆	
Scup			◆	◆	
Summer flounder			◆	◆	
Surf clam			◆	◆	
Tiger shark		◆[(a)]	◆		
Windowpane flounder	◆	◆	◆	◆	◆
Winter flounder	◆	◆	◆	◆	◆
Winter skate			◆	◆	

(a) Neonates and/or early-stage juveniles.

the Northeast Regional Office of the NMFS. To determine impact level, OCNGS monitoring data, scientific journal articles or technical reports, and other relevant information were reviewed.

Black Sea Bass (*Centropristis striata*)

Barnegat Bay is considered EFH for juvenile black sea bass. The shallow depth of Barnegat Bay prevents it from meeting EFH criteria for black sea bass adults. Juveniles enter the estuary in late spring and early summer after settlement has occurred in coastal waters, and move to warmer offshore or southern waters during the winter months. Juvenile young-of-the-year (YOY) are tolerant of temperatures of 43-86 °F (6 to 30 °C) and salinities of 8 to 38 ppt, but prefer temperatures of 63-77 °F (17 to 25 °C) and salinities of 18 to 20 ppt. In winter, juvenile black sea bass require water temperatures higher than 41 °F (5 °C) and prefer salinities of approximately 18 to 20 ppt (NMFS 1999a). The EFH of juvenile black sea bass includes shallow, hard-bottom substrates with structure present to provide protection and refuge. Suitable habitat includes oyster or mussel beds, seagrass beds, piers, wharves, artificial reefs, and cobble and shoal areas (NMFS 2006a,b,c). Juveniles do not prefer open areas, unvegetated sandy intertidal areas, or beaches. Juvenile black sea bass are diurnal, visual predators, and their diet consists of small benthic crustaceans, polychaetes, sand shrimp, amphipods, and shrimp. There is also no evidence that entrainment of prey items (e.g., sand shrimp) has significantly disrupted the population of juvenile black sea bass in Barnegat Bay. Reported losses of seagrass habitat in Barnegat Bay appear to be related to increased urbanization and possibly to alterations to Barnegat Inlet that have changed the salinity and resulted in the proliferation of algal blooms that can kill seagrass or limit light penetration and productivity (McLain and McHale 1996; BBNEP 2001; Gastrich et al. 2004). This species is not commonly impinged on OCNGS traveling screens, nor has it been identified in episodic fish kills associated with the thermal plume. Although prey items are entrained or impinged in the OCNGS cooling system, there is no indication that prey populations have been measurably affected. OCNGS operations would likely have a minimal adverse effect on juvenile black sea bass EFH.

Bluefish (*Pomatomus saltatrix*)

Barnegat Bay is considered EFH for juvenile and adult bluefish, although adults are generally not found in the bay because they require oceanic (>35 ppt) salinity. According to the NMFS (1999b), juvenile bluefish distribution over the continental shelf has not been documented; thus, it is unclear whether this life stage is estuarine-dependent. Juveniles have been observed in all estuaries within the Middle Atlantic Bight from May through October. As water temperatures cool during the autumn and winter, juveniles and adults move south. Optimum conditions for pelagic juveniles (summer cohort) include temperatures of 59 to 68 °F (15 to 20 °C) and salinities of 31 to 36 ppt. Summer cohort juveniles prefer temperatures of 68 to 86 ° F (20 to 30 °C) and salinities of 23 to 33 ppt. Bluefish are known to be voracious predators and appear to eat whatever prey items are abundant, including small fish, polychaetes, and crustaceans. It is likely that the juvenile summer-spawned cohort uses Barnegat Bay as a nursery area (Tatham et al. 1984). Although juvenile bluefish are among the species that have been killed by thermal shock associated with OCNGS operations (Kennish 2001), the number of fish kills has declined dramatically over the past decade because of improved procedures. There is no evidence that large numbers of juvenile bluefish are impinged on the OCNGS cooling system traveling screens, nor is there evidence that entrainment or impingement of prey items at OCNGS has resulted in a detectable disruption of the food web in Barnegat Bay (EA 1986; Summers et al. 1989). It appears that OCNGS operations would likely have a minimal adverse effect on bluefish EFH.

Clearnose Skate (*Raja eglanteria*)

On the basis of the distribution patterns described by NMFS (2006c), Barnegat Bay may provide EFH for juvenile and adult clearnose skates. Little information is available to determine whether juveniles and adults frequent Barnegat Bay. However, there is some evidence that they enter the coastal waters of New Jersey during the spring and early summer and move offshore and southward as the water cools during the autumn and winter (NMFS 2003a). Tatham et al. (1984) considered the clearnose skate as a local marine stray in Barnegat Bay. Clearnose skates occur over a relatively large temperature range (48 to 86 °F [9 to 30 °C]) and have been found in water with salinity ranging from 6 to greater than 35 ppt (NMFS 2003a). The optimum temperature for both juveniles and adults appears to be approximately 48 to 68°F (9 to 20 °C), and the optimum salinity appears to range from 31 and 35 ppt. Skates are often found on soft-bottom habitats along the continental shelf and have been caught in water depths ranging from approximately 1 to 300 m; they are most common in waters ranging from about 5 to 20 m. Juveniles and adults generally move inshore and northward during the spring and early summer, and offshore and southward during the autumn and early winter. Juvenile and adult clearnose skates are not commonly impinged on the OCNGS traveling screens, nor is there evidence to suggest that clearnose skates make significant use of the estuary for reproduction or nursery activities. It is also unlikely that OCNGS operations have adversely affected EFH for this species because the operational impacts on nearshore sediments are generally restricted to Oyster Creek and Forked River (EA 1986; Summers et al. 1989). Although prey items are entrained or impinged in the OCNGS cooling system, there is no indication that prey populations have been measurably affected. OCNGS operations would likely have a minimal adverse effect on EFH for adult or juvenile clearnose skates.

Dusky Shark (*Carcharhinus obscurus*)

According to the NMFS (2006c), Barnegat Bay is designated as EFH for dusky shark neonates and early-stage juveniles. Shallow bays and estuaries are used as nursery areas for young sharks. After giving birth, females leave the estuary (FMNH 2006a). Adults are considered highly migratory (NMFS 2006d) and generally move north during the summer and south during the winter. Adults avoid low-salinity conditions and rarely enter estuaries. This species was not identified in Barnegat Bay by Tatham et al. (1984). EFH for neonates and early-stage juveniles is considered to be shallow coastal waters, inlets, and estuaries to depths of approximately 25 m (NMFS 2006d), and it appears that the young sharks are tolerant of both temperature and salinity extremes common to estuaries. Because recently born sharks are approximately one m in length, their diet is assumed to be similar to adults and includes a variety of fish and invertebrates occurring near the bottom. This species was not commonly impinged (EA 1986; Summers et al. 1989), and dusky sharks have not been found in OCNGS fish kills. Although prey items are entrained or impinged in the OCNGS cooling system, there is no indication that prey populations have been measurably affected. OCNGS operations would likely have a minimal adverse effect on EFH for neonates and early-stage juveniles.

Little Skate (*Leocoraja erinacea*)

On the basis of the distribution patterns presented in NMFS 2006c, Barnegat Bay likely contains EFH for juvenile and possibly adult little skates. Adults and juveniles generally move into shallow coastal areas and estuaries during the spring and summer, and into deeper water during the winter. They may also leave estuaries for deeper waters during warm summer months (NMFS 2003b). Juvenile skates are generally found in water depths ranging from 1 to 400 m, but are most common in depths of 5 to 8 m. They are able to tolerate temperatures ranging from 32 to 45 °F (0 to 7 °C) in the winter and 57 to 72 °F (14 to 22 °C) in the summer, and salinity ranging from approximately 15 to 35 ppt. Adults and juveniles collected from the New York Bight were found at a mean temperature of 47 °F (8.5 °C) and a mean salinity of 32 ppt (NMFS 2003b). Preferred prey items for adult and juvenile little skates include decapod crustaceans and amphipods. Fish and squid are also eaten. On the basis of studies of the OCNGS once-through cooling system, entrainment of early life stages of fish and invertebrates has not adversely affected the prey items of Barnegat Bay that could potentially support juvenile and adult skates, nor is this species commonly impinged on the traveling screens associated with the cooling-water intakes. Although fish kills due to thermal fluctuations have occurred, little skate was not among the species killed. OCNGS operations would likely have a minimal adverse effect on EFH for juvenile and adult little skate.

Red Hake (*Urophycis chuss*)

Barnegat Bay is considered EFH for eggs and larvae of the red hake. Red hake are demersal fish common along the New Jersey coastline. Spawning adults are known to frequent coastal ports, and spawning occurs from about April to November at temperatures between 41 and 50 ° F (5 and 10 °C) (NMFS 1999c). Eggs are about 0.6 to 1.0 mm in diameter and float near the water surface. EFH for red hake eggs includes surface waters of the middle Atlantic region at sea surface temperatures below 50 °F (10 °C) and salinities of less than 25 ppt. Eggs are usually observed from May to November, with peak densities during June and July (NMFS 2006a,c). Temperature dependent hatching occurs at temperatures ranging from 37 to 45 °F (3 to 7 °C). Larvae of red hake are less than 2.0 mm at hatching and dominate the ichthyoplankton during the late summer months in the Middle Atlantic Bight (NMFS 1999c). EFH for larval red hake includes surface waters of the middle Atlantic region at depths less than 200 m, temperatures less than 66 °F(19 °C), and salinities greater than 0.5 ppt. Larvae are observed from May to December, with peak densities in September and October (NMFS 2006b). Larvae are nocturnal feeders that prey upon copepods and other microcrustaceans. On the basis of results of the 316(b) demonstration study at OCNGS (EA 1986; Summers et al. 1989), eggs and larvae of red hake were not identified in entrainment samples at OCNGS, nor is there evidence that entrainment or thermal fluctuations associated with the facility have resulted in a detectable disruption of food web dynamics in the estuary with respect to the presence and abundance of microcrustacean prey items. OCNGS operations would likely have a minimal adverse effect on EFH for red hake eggs and larvae.

Sandbar Shark (*Carcharhinus plumbeus*)

Barnegat Bay is considered EFH for neonate, juvenile, and adult sandbar sharks. Sandbar sharks are bottom-dwelling and represent one of the most numerous shark species in the western Atlantic. EFH requirements for neonates and early juveniles (90 cm or less) include shallow coastal waters at depths reaching 25 m, and nursery areas generally located in shallow coastal waters with temperatures higher than 70 °F (21 °C) and salinities greater than 22 ppt (NMFS 2006b). EFH for late-stage juveniles and subadults (91 to 179 cm) is identified in coastal and pelagic waters near Barnegat Inlet that range in depth from 25 to 200 m (NMFS 2006c). EFH for adult sandbar sharks (>179 cm) includes shallow coastal areas to a depth of 50 m. Temperature and salinity preferences for various life stages are assumed to be typical of estuaries. Sandbar sharks are opportunistic feeders, and prey items commonly include small fish, molluscs, and crustaceans. Some of these prey are commonly impinged at OCNGS. The sandbar shark was not identified as a common species in Barnegat Bay by Tatham et al. (1984), juveniles and adults are not routinely impinged on the OCNGS traveling screens (EA 1986; Summers et al. 1989), and this species has not been found in OCNGS fish kills (Kennish 2001). OCNGS operations would likely have a minimal adverse effect on EFH for this species.

Scup (*Stenotomus chrysops*)

Barnegat Bay contains EFH for the both juvenile and adult scup. Scup are considered a temperate species, with a range extending from Massachusetts to South Carolina, and are common in the summer and early fall in coastal estuaries containing both open and structured environments (NMFS 1999d). Tatham et al. (1984) considered scup a local marine stray in Barnegat Bay. Juveniles are found in water depths ranging from intertidal to approximately 39 m; they prefer water temperatures of approximately 61 to 70 °F (16 to 22 °C), but are found in water with temperatures higher than 45 °F (7 °C) in winter. Juveniles in estuaries are found at salinities greater than 15 ppt; those in coastal environments are found at salinities exceeding 30 ppt. The primary prey items for juveniles include small benthic invertebrates, fish eggs, and larvae. EFH for juvenile scup includes the demersal waters over the continental shelf and estuaries where juvenile scup are abundant. In estuaries like Barnegat Bay, juveniles are commonly found in sandy and muddy environments, near mussel and eelgrass beds where water temperatures are higher than 45 °F (7 °C) and salinities are greater than 15 ppt. In summer, adult scup are found in water depths of approximately 2 to 38 m, at temperatures ranging from 45 to 77 °F (7 to 25 °C), and at salinities greater than 15 ppt. In winter, adults are generally found offshore in water depths ranging from 38 to 185 m, water temperatures higher than 45 °F (7 °C), and salinities exceeding 30 ppt (NMFS 2006b). Adult scup feed on small benthic invertebrates and small fish. EFH for adult scup is similar to that described for juveniles. Fish kills at OCNGS have included scup, but fewer than 10 individuals were killed per event. Previous studies and the conclusions of Kennish (2001) indicate that there is no evidence that OCNGS operations have resulted in detectable changes in scup prey populations. On the basis of work by Tatham et al. (1984), scup were not abundant in Barnegat Bay during the 1980s, nor were they commonly entrained at OCNGS (EA 1986; Summers et al. 1989). OCNGS operations would likely have a minimal adverse effect on EFH for scup juveniles and adults.

Summer Flounder (*Paralichthys dentatus*)

Barnegat Bay is considered EFH for summer flounder juveniles and adults. Summer flounder are common in coastal and estuarine waters from Nova Scotia to Florida; the highest abundances are associated with waters of the Middle Atlantic Bight (NMFS 1999e). Tatham et al. (1984) considered this species a warmwater migrant in Barnegat Bay. Summer flounder exhibit a strong seasonal migration pattern that finds them in shallow coastal and estuarine waters during the spring and summer, and in deeper offshore waters during the fall and winter. EFH for juveniles includes demersal waters over the continental shelf, and estuaries where juveniles have been observed. Nursery habitat used by juvenile flounder in Barnegat Bay includes salt marsh creeks, seagrass beds, mudflats, and open bay areas. Preferred water temperature is higher than 37 °F (3 °C), and preferred salinities range from 10 to 30 ppt. EFH for adult summer flounder includes demersal waters over the continental shelf at water depths to 152 m and coastal systems similar to Barnegat Bay (NMFS 2006c). Juvenile and adult summer flounder are opportunistic feeders; juveniles appear to prefer crustaceans and polychaetes, while larger individuals appear to prefer crustaceans and fish. The primary impacts of OCNGS operations on summer flounder EFH are expected to be impingement of juveniles and adults on OCNGS traveling screens, and impacts associated with the OCNGS thermal discharges. Annual summer flounder impingements ranged from 1308 to 4266 individuals. This represented less than 0.2 percent of the total number of individual fish impinged during that period and was considered inconsequential by EA (1986), given the number of fish caught by recreational anglers during that period. Fish kills associated with thermal fluctuations at OCNGS did not include summer flounder (Kennish 2001). Also, there is no evidence to suggest that the operation of the facility has significantly affected the prey of this species (EA 1986; Summers et al. 1998). Thus, OCNGS operations would likely have a minimal adverse effect on EFH for this species.

Surf Clam (*Spisula solidissima*)

The coastal region adjacent to Barnegat Bay is considered EFH for juvenile and adult surf clams. Both adults and juveniles are found along the Atlantic Coast from the Gulf of St. Lawrence to Cape Hatteras, from the beach zone to a water depth of approximately 60 m

(FWS/DOI/USACE 1983; Weinberg 2000; NJDEP 2005b). The species prefers oceanic salinities (>32 ppt) and temperatures ranging from 59 to 86 °F (15 to 30 °C). Both juveniles and adults are filter-feeders, and their diet consists of a variety of algae associated with the sediment surface and the water column. EFH for juveniles and adults includes substrates to a depth of one m below the water-sediment interface in waters from the eastern edge of Georges Bank and the Gulf of Maine through the Atlantic Exclusive Economic Zone, in areas that encompass the top 90 percent of all ranked 10-minute squares for the areas where surf clams were caught during the Northeast Fisheries Science Center surf clam and ocean quahog dredge surveys (NMFS 2006c). Because surf clams are known to burrow in medium to coarse sand and gravel substrates, they may occur in Barnegat Bay near the Barnegat Inlet. It is unlikely that OCNGS operations impact the EFH or food supply of surf clams because they are generally found in coastal rather than estuarine waters. Surf clam larvae have not been reported in OCNGS entrainment samples, and hydrodynamic modeling indicates that the OCNGS thermal plume does not extend to Barnegat Inlet (EA 1986). Although the number of surf clams appears to have decreased since 1996, a variety of factors are likely responsible for the decline, including a change in ambient water temperature due to a warm water intrusion over the mid-Atlantic shelf. This intrusion may be responsible for the mortality of larger clams, and the gradual northward shift of the population (Weinberg 2000). In conclusion, no adverse effect on surf clam EFH is expected from continued OCNGS operations.

Tiger Shark (*Galeocerdo cuvier*)

Barnegat Bay is considered EFH for neonate and juvenile tiger sharks (NMFS 2006b). This species is common throughout the world in temperate waters and exhibits a high tolerance for many different kinds of marine habitats, including rivers, estuaries, harbors, and other nearshore locations where there are numerous prey items (FMNH 2006b). Adults migrate north from tropical to temperate waters during the summer months and return to the tropics during the winter. Mating occurs between March and May, and young are born between April and June of the following year. EFH for neonates and juveniles includes shallow coastal waters to a depth of 200 m from Cape Canaveral, Florida, to offshore Montauk, Long Island, New York (NMFS 2006c). Adults are known to feed on a variety of fish and invertebrates, and it is assumed that juveniles share this characteristic. Juveniles are not routinely impinged on the traveling screens associated with the circulating-water cooling system, nor is there evidence to suggest that plant operations have significantly affected prey populations (Kennish 2001). OCNGS operations would likely have a minimal adverse effect on EFH of the tiger shark.

Windowpane Flounder (*Scophthalmus aquosus*)

Barnegat Bay is considered EFH for all life stages of the windowpane flounder, including spawning adults (NMFS 2006b). This species occurs in estuaries, nearshore waters, and waters associated with the continental shelf along the Atlantic Coast from the Gulf of

St. Lawrence to Florida, and is most abundant in water depths of two m or less (NMFS 1999f). Eggs are buoyant and are typically found in surface waters, with greatest abundance between May and October. Larvae are approximately 2 mm long at hatching, and metamorphose into juvenile forms when they reach a length of approximately 5.5 mm; they settle to the bottom when they reach a total length of approximately 10 mm (Bigelow and Schroeder 1953). Juveniles typically reach a size range of 11 to 19 cm about 4 months after spawning, and the total length of adults is about 46 cm (NMFS 1999f). Adults generally spawn from February to December, with peak spawning occurring in May in the middle-Atlantic region (NMFS 2006a). Juvenile and adult windowpane flounder feed on small crustaceans (mysid shrimp and decapods) and larval forms of fish.

EFH for eggs includes surface waters extending from the Gulf of Maine to Cape Hatteras. Optimum water temperatures are less than 68 °F (20 °C) and water depths of less than 70 m (NMFS 2006c). EFH for larvae is similar to that described for eggs. EFH for juvenile windowpane flounder includes mud or fine-grained sand substrates with water temperatures below 77 °F (25 °C), depths of 1 to 100 m, and salinities between 5.5 and 36 ppt (NMFS 2006c). EFH for adults is similar to that described for juveniles, with water temperatures below 81 °F (27 °C). Spawning adults in the mid-Atlantic region prefer habitats with mud or fine-grained sand, water temperatures below 70 °F (21 °C), salinities ranging from 5.5 and 36 ppt, and water depths ranging from 1 to 75 m. The peak spawning period is May (NMFS 2006c).

Because all life stages of windowpane flounder could occur in Barnegat Bay, it is possible that OCNGS activities could adversely affect EFH for this species. Tatham et al. (1984) considered the windowpane flounder a local marine stray and did not consider it to be an abundant species based on trawl studies in the study area from 1975 to 1978, nor was it designated as a species that uses the estuary for spawning or as a nursery area. On the basis of commercial landing data for this species for the state of New Jersey provided by the NMFS (2005), commercial landings of windowpane flounder during the Tatham et al. study period ranged from 0 to 0.6 metric tons, and were less than 4.5 metric tons from 1971 to 1996. This could account for the low abundances of this species in Barnegat Bay. Commercial landings in New Jersey increased dramatically after 1996, peaking at 51 metric tons in 2001. Commercial landings of windowpane flounder have declined since 2001 and accounted for 16.9 metric tons in 2004 (NMFS 2005).

The results of studies conducted at OCNGS between 1965 and 1977 suggest that eggs and larvae of windowpane flounder are not commonly entrained, and there was no evidence of significant impingement of this species during that time (EA 1986; Summers et al. 1989). In addition, this species has not been found in fish kills resulting from OCNGS operations (Kennish 2001). Unfortunately, most of the relevant information collected to determine potential OCNGS impacts occurred during a period of low abundance of this species (NMFS 2005).

Detailed abundance, entrainment, and impingement data are not available for Barnegat Bay during years when commercial landings were at historical highs (1997 to 2004). Therefore, it is not possible to quantify EFH impacts for this species during that period. Despite this, it appears likely that the general conclusions stated in EA (1986), Summers et al. (1989), and Kennish (2001) are still valid. All three sources concluded that the operation of OCNGS did not result in a discernable effect on invertebrate or fish communities in Barnegat Bay. OCNGS operations are expected to result in a minimal adverse effect on EFH for windowpane flounder eggs, larvae, juveniles, adults, and spawning adults.

Winter Flounder (*Pseudopleuronectes americanus*)

Barnegat Bay is considered EFH for all lifestages of the winter flounder, including spawning adults. Winter flounder represent a valuable recreational and commercial resource along the Atlantic Coast; this species is ubiquitous in inshore areas from Massachusetts to New Jersey (NMFS 1999g). Winter flounder eggs are adhesive and occur in clusters. Larval forms are initially planktonic and begin to settle to the bottom when they reach a length of approximately 9 to 13 mm. In New Jersey waters, YOY and juvenile winter flounder are found in shallow water, where they may grow from 0.23 to 0.47 mm per day (NMFS 1999g). Adults can grow to a length of 58 cm and may live up to 15 years. Adults enter nearshore estuaries and rivers during the fall and early winter and spawn in late winter and early spring. After spawning, adults typically leave inshore areas. Winter flounder larvae eat small planktonic organisms (copepods, eggs, and phytoplankton); juveniles and adults are opportunistic feeders, and their diets include polychaetes and crustaceans. EFH for winter flounder eggs consists of bottom habitats with sand, muddy sand, and gravel substrates; a depth range of 0.3 to 4.5 m, an optimum temperature range of 37 to 41 °F (3 to 5 °C), and a preferred salinity range of 10 to 32 ppt (NMFS 1999g; NMFS 2006a). EFH for larvae includes shallow (1 to 4.5 m) inshore areas with a fine sand to gravel substrate, temperatures of 36 to 59 °F (2 to 15 °C), and a salinity range of 3.2 to 30 ppt. YOY and juveniles prefer a habitat consisting of mud or sand (with shell fragments) and water depths ranging from approximately 0.5 to 27 m. Preferred temperatures range from 36 to 84 °F (2 to 29 °C) for YOY and from 50 to 77 °F (10 to 25 °C) for juveniles. Preferred salinity ranges are approximately 23 to 33 ppt for YOY and 19 to 21 ppt for juveniles. Adult winter flounder are typically found in 1 to 30 m of water with a mud, sand, or large cobble substrate. The preferred water temperature range is 54 to 59 ° F (12 to 15 °C), and the preferred salinity range is 15 to 33 ppt.

OCNGS operations have the potential to adversely affect EFH for all life stages of winter flounder because all stages could occur in Barnegat Bay. Tatham et al. (1984) considered the winter flounder a resident species in Barnegat Bay that made significant use of the estuary for spawning and as a nursery area; the years of study (1975 to 1978) reflected a period when commercial landings in New Jersey waters ranged from 47.7 to 92.7 metric tons. These data appear to reflect a low point in the population based on data from 1979 to 2004, when catches usually exceeded 100 metric tons and were greater than 200 metric tons for seven years during that period (NMFS 2005). Winter flounder larvae represented between 1 and 10 percent of the annual OCNGS entrainment measured in studies from 1975 to 1981 (Summers et al. 1989). Juvenile and adult opossum shrimp represented the largest percentage of organisms entrained during that period (49 to 91 percent). The total number of entrainment losses for winter flounder larvae for 1975 to 1976, 1977 to 1978, and 1980 to 1981 was 4330 million organisms (Summers et al. 1989). Opossum shrimp entrainment losses during this same period were 209,889 million organisms (Summers et al. 1989). Winter flounder are also impinged on the OCNGS traveling screens. Annual impingement of winter flounder from 1975 to 1985 ranged from 8908 individuals in 1975 to 1976, to more than 148,000 individuals from 1978 to 1979), and the average annual impingement was estimated (EA 1986) to be 38,866 individuals during that period. These totals represented less than 1.5 percent of the total impingements observed at the facility during the study period (sand shrimp and blue crab accounted for the majority of the impingements) and less than 1 percent of the total population in Barnegat Bay during that time. It is likely the winter flounder impingement losses are actually lower than those described in EA (1986) because they did not reflect the high survival observed in impinged organisms (77 to 94 percent) (Summers et al. 1989). Although thermal fluctuations associated with OCNGS operations have caused significant fish kills, winter flounder have not been among the affected species (Kennish 2001).

On the basis of the results of OCNGS studies (EA 1986; Summers et al. 1989) and the results reported in Kennish (2001), OCNGS operations have not resulted in discernable changes in invertebrate or fish communities in Barnegat Bay. OCNGS does not appear to adversely affect winter flounder egg EFH, since the eggs are demersal, adhesive, and occur in clusters. OCNGS operations would likely have a minimal adverse effect on EFH for larvae, juveniles, adults, and spawning adults of the winter flounder.

Winter Skate (*Leucoraja ocellata*)

On the basis of the distribution patterns described in NMFS (2006c), Barnegat Bay may provide EFH for both juvenile and adult winter skate. This species is common along the Atlantic Coast, with a range extending from the Gulf of St. Lawrence to Cape Hatteras. The population center is believed to be on Georges Bank (NMFS 2003c). EFH for juvenile and adult winter skates includes sand- and gravel-bottom substrates at depths of up to 300 m. During the spring, juveniles are found in water temperatures ranging from 34 to 54 °F (1 to 12 °C), with the majority occurring in temperatures of 39 to 41 °F (4 to 5 °C) and a salinity range of 32 to 33 ppt. During the fall, juveniles occur in water temperatures ranging from 41 to 70 °F (5 to 21 °C), with peak abundances observed at 59 °F (15 °C) and in salinities of 32 and 33 ppt (NMFS 2003c). Adult winter skates are found year round at temperatures ranging from 36 to 52 °F (2 to 11 °C) and depths ranging from 31 to 60 m. Adults are typically found at salinities ranging from 30 to 36 ppt. Juvenile and adult winter skates are bottom feeders and preferred prey include polychaetes and crustaceans. Crustaceans are believed to make up more than 50 percent of their diet (NMFS 2003c). Because this species generally occurs in water with salinities greater than 32 ppt, it is not likely that this species spends a significant amount of time in the western portion of Barnegat Bay. However, it may frequent the eastern portion where higher salinity exists near the Barnegat Inlet. Tatham et al. (1984) did not identify winter skate as a common species in Barnegat Bay, nor are juveniles or adults routinely impinged on OCNGS traveling screens (EA 1986; Summers et al. 1989). This species was not identified in OCNGS fish kills (Kennish 2001). Current OCNGS operations may entrain or impinge some winter skate prey, but there is no evidence that prey populations have been measurably affected. OCNGS operations would likely have a minimal adverse effect on winter skate EFH for juveniles and adults.

7.0 MITIGATION MEASURES

Three categories of impacts related to OCNGS operations that could influence EFH are: (1) release of heated cooling water containing biocides or other chemicals; (2) entrainment of eggs, larvae, or phytoplankton and zooplankton in the water column; and (3) impingement of juveniles or adults. These operations are regulated under a NJPDES permit that is currently under review for extension to April 30, 2009. The NJDEP developed a fact sheet (NJDEP 2005a) that describes the agency's assessment of impacts and potential mitigation alternatives that may be necessary to comply with Phase II requirements of Section 316(b) of the Clean Water Act.

The existing dilution-pump system was designed to mitigate thermal effects in the discharge canal, Oyster Creek, and Barnegat Bay. Water at ambient temperature is pumped directly from the intake canal to the discharge canal where it mixes with the heated discharged water. The dilution water serves to reduce the temperature of the discharged circulation water immediately. Such temperature reduction greatly reduces any potential thermal effects on EFH in the discharge canal, Oyster Creek, and Barnegat Bay.

The NJDEP has granted OCNGS a variance from thermal surface-water quality standards for heat and temperature pursuant to Section 316(a) of the Clean Water Act. This variance was granted based on the assessment by Summers et al. (1989) that the operation of OCNGS did not appear to produce long-term population or ecosystem level impacts. Thus, the draft NJPDES permit does not require additional mitigation measures for thermal discharges beyond those already stipulated in the existing permit, which include temperature monitoring at various locations near OCNGS and plant shutdown restrictions during December, January, February, and March to reduce the possibility of fish kills related to cold shock.

Current mitigation measures also are in place to reduce effects of impingement on EFH in Barnegat Bay, Forked River, and the intake canal. In 1984, the circulating-water intake was fitted with 3/8-in.-mesh traveling screens with Ristroph buckets and a screen-wash and fish-return system. Impinged organisms are washed into or fall into the buckets; the buckets deliver the organisms into the fish-return system, which transports them to the discharge canal where the dilution water enters the canal. Such mitigation measures greatly reduce the effects of impingement on EFH, including various life stages of prey species, in the Barnegat Bay system.

The fact sheet also addresses the impacts of entrainment and impingement by evaluating the potential losses of representative important species using three population models: equivalent adult model, production foregone model, and spawning/nursery area of consequence model. Although the NJDEP acknowledged the conclusion of Summers et al. (1989) that OCNGS operations did not appear to produce "unacceptable, substantial long-term population and ecosystem level impacts," the agency stated that it is not necessary to prove that an impact on a population is occurring to trigger the 2004 EPA Phase II Section 316(b) requirements. The NJDEP went on to state that "this rationale is consistent with the Phase II regulations which specify compliance alternatives, including national performance standards, and do not define adverse environmental impact." The National entrainment performance standard requires that entrainment mortality for all life stages of fish and shellfish be reduced by 60 to 90 percent from the calculated baseline, though there is no guidance on how the baseline is to be calculated. Impingement mortality is to be reduced by 80 to 90 percent from the calculated baseline. In addition to compliance with these performance standards, the NJDEP has indicated that AmerGen should initiate a wetlands restoration and enhancement program, within the Barnegat Bay estuary, to offset any residual impingement and entrainment losses at the facility. If such mitigation were to occur, it is likely that the potential impact of OCNGS activities on EFH would be further reduced during the license renewal period.

8.0 CONCLUSION

The expected impacts of OCNGS operations on EFH is summarized in Table 5. Because OCNGS operates a once-through cooling system, it has the potential to create a substantial adverse impact on EFH due to the withdrawal of water from the Forked River and Barnegat Bay. However, the general lack of interaction between EFH species and the facility, as well as current mitigation measures in place at OCNGS, reduce the potential adverse effect on EFH. OCNGS operations do not have an adverse effect on the food web in Barnegat Bay. The NRC staff concludes that license renewal for OCNGS for an additional 20 years of operation would result in a minimal adverse effect on EFH.

Table 5. Impacts of OCNGS Operations on EFH

Species	Life Stage	EFH Description	Expected Effect of OCNGS Operations on EFH
Black sea bass	Juveniles	Shallow water hard substrate with refuge. Temperatures of 17 to 25°C, and salinity of 18 to 22 ppt.	**Minimal Adverse Effect**. Probably does not frequent nearshore areas near OCNGS and not commonly impinged. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
Bluefish	Juveniles	Habitat requirements not specified. Summer cohort temperatures of 20 to 30°C, and salinity of 31 to 36 ppt.	**Minimal Adverse Effect**. Not commonly impinged. Some documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
Clearnose skate	Juveniles	Soft-bottom substrate. Temperatures of 9 to 20°C, and salinity of 31 to 35 ppt.	**Minimal Adverse Effect**. Not common in Barnegat Bay or commonly impinged, no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Same as juveniles	**Minimal Adverse Effect**. Same as juveniles.
Dusky shark	Neonates and juveniles	Shallow coastal waters to 25 m. Temperature of about 19°C, and salinity of >30 ppt.	**Minimal Adverse Effect**. Not common in Barnegat Bay or commonly impinged, no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
Little skate	Juveniles	Shallow coastal water and estuaries (5 to 8 m). Temperatures of 0 to 7°C (winter), and 14 to 22°C (summer). Salinity of 15 to 35 ppt.	**Minimal Adverse Effect**. Not common in Barnegat Bay or commonly impinged, no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Same as juveniles.	**Minimal Adverse Effect**. Same as juveniles.
Red hake	Eggs	Surface waters of mid-Atlantic region. Temperature of <10°C, and salinity of <25 ppt.	**No Adverse Effect.** Not commonly entrained.
	Larvae	Surface waters of mid-Atlantic region. Temperature of <19°C, and salinity of >0.5 ppt.	**Minimal Adverse Effect.** Not commonly entrained. Prey items are entrained at OCNGS, but prey population size not affected.

Table 5. (contd)

Species	Life Stage	EFH Description	Expected Effect of OCNGS Operations on EFH
Sandbar shark	Neonates and juveniles	Shallow coastal waters (25 to 200 m). Temperature of >21°C, and salinity of >22 ppt.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged, no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Shallow coastal waters (<50 m). Temperature and salinity similar to coastal estuaries with oceanic influence.	**Minimal Adverse Effect.** Same as juveniles.
Scup	Juveniles	Sandy or muddy habitat. Temperature of >7°C, and salinity of >15 ppt.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged. Some documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Same as juveniles.	**Minimal Adverse Effect.** Same as juveniles.
Summer flounder	Juveniles	Coastal estuaries with seagrass, mudflats, or open areas. Temperature of >3°C, and salinity 10 to 30 ppt.	**Minimal Adverse Effect.** Some annual impingement mortality, but no observed population impacts. No documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Demersal waters over continental shelf, oceanic conditions.	**Minimal Adverse Effect.** Same as juveniles.
Surf clam	Juveniles	Coastal water in medium and coarse sand/gravel at water depths to 60 m.	**No Adverse Effect.** Limited distribution in Barnegat Bay. Prey abundance probably not influenced by operations.
	Adults	Same as juveniles.	**No Adverse Effect.** Same as juveniles.
Tiger shark	Neonates and juveniles	Shallow coastal waters to a depth of 200 m.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged. No documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
Windowpane flounder	Eggs	Surface water with temperatures <20°C.	**Minimal Adverse Effect.** Limited distribution in Barnegat Bay. Eggs not commonly entrained.

Table 5. (contd)

	Species	Life Stage	EFH Description	Expected Effect of OCNGS Operations on EFH
1		Larvae	Same as eggs.	**Minimal Adverse Effect.** Limited distribution in Barnegat Bay. Larvae not commonly entrained. Prey items are entrained at OCNGS, but prey population size not affected.
2		Juveniles	Mud or fine-grained sand habitat at depths of 1 to 100 m. Temperature of <25°C, and salinity of 5.5 to 36 ppt.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged. No documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
3		Adults	Mud or fine-grained sand habitat at depths of 1 to 75 m. Temperature of <26.8°C, and salinity of 5.5 to 36 ppt.	**Minimal Adverse Effect.** Same as juveniles.
4		Spawning adults	Mud or fine-grained sand habitat at depths of 1 to 75 m. Temperature of <21°C, and salinity of 5.5 to 36 ppt.	**Minimal Adverse Effect** Same as juveniles.
5	Winter flounder	Eggs	Sand, muddy sand, and gravel habitat with depths of 0.3 to 4.5 m. Temperatures of 3 to 5°C, and salinity of 10 to 32 ppt.	**No Adverse Effect** Eggs demersal and adhesive. Not reported from entrainment samples.
6		Larvae	Shallow (1 to 4.5 m) inshore areas with fine sand to gravel substrate. Temperatures of 3 to 5°C, and salinity of 10 to 32 ppt.	**Minimal Adverse Effect.** Some annual entrainment loss. No documented thermal shock mortality. Prey items entrained at OCNGS, but prey population size not affected.
7		Juveniles	Mud or sand habitat with shell hash. Water depths of 0.5 to 27 m, temperatures of 2 to 29°C, and salinity of 19 to 33 ppt.	**Minimal Adverse Effect.** Some annual impingement loss, but no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
8		Adults	Mud, sand, or large cobble substrate, depths of 1 to 30 m. Temperatures of 12 to 15°C, and salinity of 15 to 33 ppt.	**Minimal Adverse Effect.** Same as juveniles.
9		Spawning adults	Same as adults.	**Minimal Adverse Effect.** Same as juveniles.

Table 5. (contd)

Species	Life Stage	EFH Description	Expected Effect of OCNGS Operations on EFH
Winter skate	Juveniles	Sand and gravel substrates to 300 m. Springtime temperatures of 4 to 5°C, and salinities of 28 to 32 ppt. Fall temperatures of 5 to 21°C, with peak abundance at 15°C, and salinities of 31 to 35 ppt.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged. No documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adult	Sand and gravel substrates to 300 m. Springtime temperatures of 4 to 5°C and salinities of 28 to 32 ppt. Fall temperatures of 5 to 21°C, with peak abundance at 15°C and salinities of 31 to 35 ppt.	**Minimal Adverse Effect.** Same as juveniles.

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